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**National
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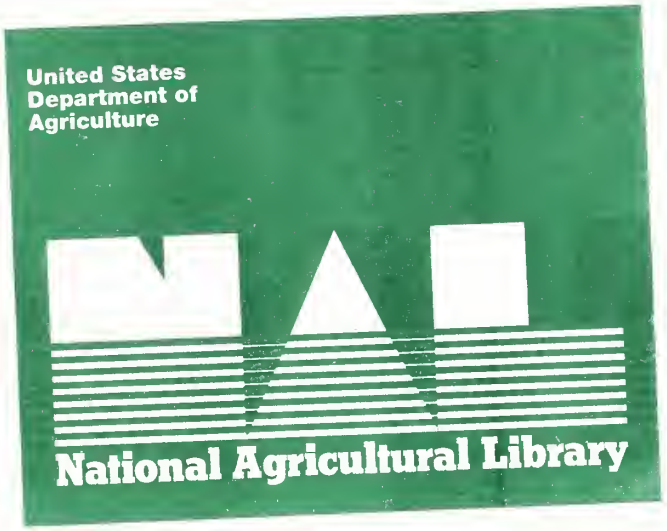
Effects of Casein Imports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ABSTRACT

This study, directed by the Food Security Act of 1985, examines the supply of and demand for imported casein in the United States and the effects on the dairy price support program of possible actions to limit imports. A 50-percent quota (based on average 1981-85 imports) would cause casein prices to rise to a price equivalent to nonfat dry milk, replacing much casein with soy, whey, and other proteins. It would raise ingredient costs of cheese analogs to about the level of natural cheese and perhaps, replace some analogs with natural or processed cheese. A 50-percent tariff would raise casein prices and shift many users to soy, whey, or other ingredients, but not reduce CCC costs.

Keywords: casein, Section 22, dairy price support program, imports

This report was prepared in the National Economics Division by Alden C. Manchester with contributions from Ann Tutwiler and William Paddock. It updates U.S. CASEIN AND LACTALBUMIN IMPORTS: AN ECONOMIC AND POLICY PERSPECTIVE, ERS Staff Report AGES810521, June 1981, prepared by Kenneth C. Clayton, Felix Spinelli, Thomas Stucker, Howard Leathers, James Johnson, and Letricia Womack.

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SUMMARY

This study, requested by the Food Security Act of 1985, examines the economic implications of imported casein used in food, feed, and industrial products and the economic effects of restrictions that might be placed on the availability of these imported proteins. The effects of such restrictions would be felt by manufacturers of products using casein; by consumers of products containing casein; by manufacturers of domestic dairy products; by U.S. farmers; and by the U.S. Government through the effect that such a limitation might have on the cost of the dairy price support program. In addition, restrictions would affect casein-exporting countries and, as a consequence, might affect existing or potential trade agreements.

Those who favor import restrictions on casein assert that these imported dairy proteins displace domestic skim milk solids in commercial channels and make the cost of the dairy price support program higher. Suppliers and users of casein do not agree with this view. They argue that these imported dairy proteins are unique inputs that do not displace significant quantities of domestic skim milk solids. Some also suggest that certain products would not be produced if imported casein were unavailable.

Of the 229 million pounds net imports of casein in 1985, about 196 million pounds were used in manufacturing with about 33 million pounds added to inventory. Major suppliers of casein in 1985 included New Zealand (44 percent), Australia (5 percent), and the European Community (45 percent). Since the late sixties, there has been no domestic production of casein. The U.S. support price for nonfat dry milk has made domestic casein production noncompetitive.

In New Zealand and Australia, some amount of subsidization does occur but the cost of producing milk is significantly lower than elsewhere. The European Community subsidizes casein production as a method of disposing of surplus skim milk.

The end uses of casein fall into three groups. First, those applications (including industrial products, most animal feed, and pet food) in which soy proteins or other ingredients could replace casein. This replacement has already been occurring and would be further encouraged if the price of casein rose moderately. These applications consumed about 51 million pounds of casein in 1985 (group C in figure A).

Second, those applications (including cheese analogs, some coffee whitener, and some animal feed uses) in which skim milk solids could replace casein. This replacement would occur if the price of casein rose to a level where it was equivalent, on a protein basis, to the price of nonfat dry milk (more than double its 1985 price). These applications used about 94 million pounds of casein in 1985 (group B in figure A). As the price of casein rises, the quantity of casein used in Group B applications declines. This is because higher casein prices result in higher consumer prices for the end products. Faced with higher prices, consumers buy less of these end products.

Third, those applications (including dietary and pharmaceutical products and most coffee whitener and toppings) which require the special characteristics of casein. These applications used about 51 million pounds in 1985 (group A in figure A).

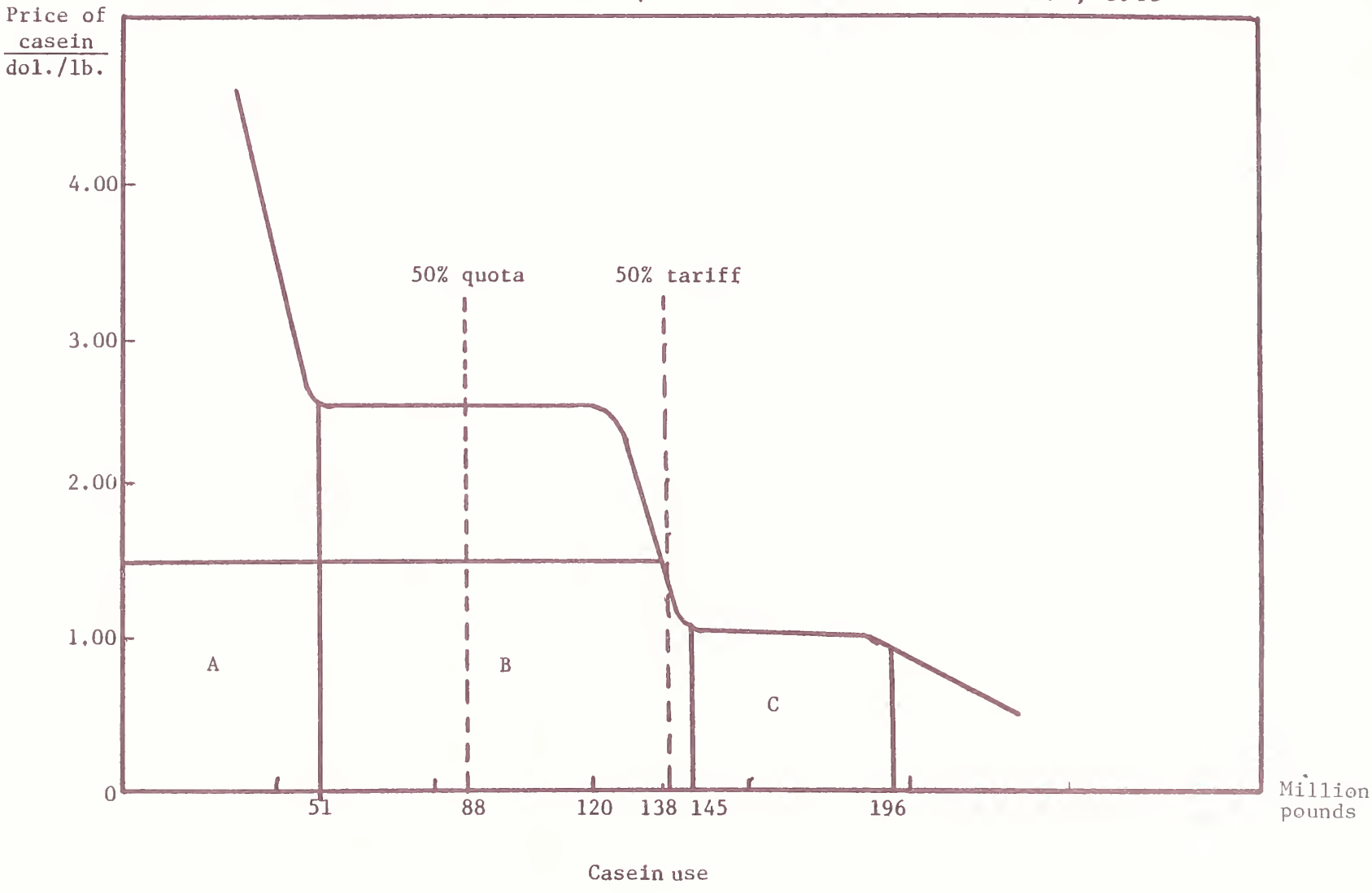
Under Section 22 of the Agricultural Adjustment Act, the United States cannot completely prohibit imports of casein. The most extreme restrictions that may be imposed are a 50-percent tariff or a quota equal to 50 percent of the amount imported during a representative period. This study identifies the effects that these restrictions might have on uses of casein, on consumers of products containing casein, and on the cost of the dairy price support program.

Imposition of a 50-percent quota (based on average 1981-85 imports) would limit imports to 88 million pounds of casein. The price of casein would rise to the protein equivalent of the nonfat dry milk price. This price would precipitate the replacement of casein with soy, whey, and other ingredients. It would also cause a decline in casein use due to decreased purchases of the affected end-products. At these price levels, domestic production of casein would become potentially feasible and cheese analogs might not be a lower cost alternative to natural and especially to processed cheese. Therefore, a part of cheese analogs would be replaced by non-casein cheese, reducing CCC purchases of cheese and price support program costs by about $84-300 million. Consumer expenditures would increase by about $180 million.

A 50-percent tariff would cause the price of casein to increase to about $1.44 per pound ($0.48 greater than the 1985 price of $0.96). This price is still lower than the protein equivalent nonfat dry milk price. Therefore, the tariff would cause a shift in some applications to soy, whey, or other ingredients, but would not cause much increase in commercial demand for skim milk solids. Thus, a 50-percent tariff would have little impact on the cost of the price support program. Consumer expenditures would increase by about $66 million.

Either a quota or a tariff would raise prices of casein-using products and some might be priced out of the market. In such a situation, consumers would have fewer alternative products available to them, many at higher prices.

FIGURE A. EFFECTS OF TARIFF OR QUOTA ON CASEIN USE AND PRICE, 1985



Effects of Casein Imports

INTRODUCTION

Section 106 of the Food Security Act of 1985 requested the Secretary of Agriculture to conduct a study to determine whether imports of casein tend to interfere with or render ineffective the dairy price support program.

This report examines the conditions under which casein is produced and the economics of its use in various end-products. Particular attention is paid to the alternative ingredients available to manufacturers and processors who use casein. Knowledge of the conditions under which these ingredients can replace each other is basic to the analysis. The information assembled is then used to evaluate whether imported milk proteins are displacing domestic dairy products in commercial use and thereby raising dairy price support program costs.1/

Casein is the principal protein in milk, accounting for roughly 3 percent of the weight of whole milk, and 80 percent of the total protein content. Whole milk is made up of fat, water, and nonfat milk solids. When the butterfat component of whole milk is skimmed off in making butter, still remaining as skim milk are casein, water, and other nonfat milk solids. This skim milk can be dried and made into nonfat dry milk (NFDM) or it can be made into casein.

When the casein is removed from skim milk, whey remains. Whey, in turn, can be broken down into lactose (milk sugar) and whey proteins which are known commercially as lactalbumin.

Casein, although derived from milk, is not included in the programs that support prices and limit imports of manufactured dairy products. In the forties, casein production used only a small percentage of milk. Also, casein was used in the manufacture of industrial rather than food products. Domestic

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1/ The time available for this study did not permit surveys of the users of casein such as those conducted by the Economic Research Service and the International Trade Commission covering 1980. The estimates of casein use in 1985 are based on much less complete information and do not purport to be anything but informed estimates. The ITC figures for 1978-80 and January-August 1981 have been used as a base, rather than the ERS estimates, since ITC obtained more complete coverage in its survey.

casein production totaled 36 million pounds in 1947, but fell to 3 million pounds in 1955 as NFDM producers diverted milk supplies away from casein production to nonfat dry milk whose price was supported. During this period, imports rose from 21 to 75 million pounds.

Casein and lactalbumin are not produced in the United States.2/

RELATIONSHIP TO PRICE SUPPORTS

The dairy price support program has undergirded the entire price structure for milk sold by farmers to processors since early in World War II. The basic mechanism has been unchanged since that time, although there have been many modifications of details, especially in recent years. The support prices are achieved through Commodity Credit Corporation (CCC) offers to buy butter, nonfat dry milk, and cheese at prices designed to return the support price to manufacturing grade milk producers on average. Thus, the price support program has directly provided a floor under the price of milk used to manufacture these products and, indirectly, supported the price of all milk.

The selection of the dairy products which CCC offers to purchase is discretionary with the Secretary. At one time, evaporated milk was included. Any other dairy product could be included, the objective being to support the price of milk to all producers. Cheese, butter, and nonfat dry milk were selected because they are widely produced throughout the dairy regions of the country and they account for the residual or marginal uses of milk.

The U.S. price support program maintains prices of dairy products above world market levels. The prices of manufactured dairy products in international trade have been low compared with the domestic prices in most producing countries ever since the dairy industries of Europe recovered from World War II. Each of the major European dairy producing countries subsidizes its domestic industry and the European Community promotes exports with substantial subsidies. In these circumstances, import controls have been necessary to prevent flooding the U.S. market with foreign dairy products.

Import quotas were first authorized under Section 22 of the Agricultural Adjustment Act of 1933, which was added to the law in 1935. They did not become applicable to dairy products until later and were first imposed in 1951 under emergency legislation. Under these regulations, imports of dairy products were held to modest levels in most years.

Quotas are applied only to products that are considered to compete directly with U.S.-produced dairy products. Nearly half of the quantity and two-thirds of the value of imports were not under quota in the late seventies. In 1980 and 1981, quotas were increased by the Tokyo Round of trade negotiations and nonquota imports fell to 12-14 percent of total imports (on a milk-equivalent, fat basis). Nonquota imports have risen since then, primarily cheeses and casein. Imports of butter, nonfat dry milk, and American-type cheese compete very directly with those products made in the

2/ Use of lactalbumin in the United States is far less extensive than the use of casein. Lactalbumin applications tend to be much more specialized and information on the use and availability of substitutes for lactalbumin is extremely limited. Lactalbumin is not considered in this report.

United States and displace them essentially pound-for-pound. More exotic cheeses which are not made in the United States compete less directly with domestic products and are not subject to quota.

Quotas or tariffs can be applied to imported dairy products on a finding by the President of material interference with the operations of the price support program. Findings of material significance have been made for butter, nonfat dry milk, cheese, ice cream, dried buttermilk and whey, evaporated milk, condensed milk, chocolate crumb, butterfat mixtures, frozen cream, and animal feed with milk solids--these products all have a quota. Casein is not on this list because, when the quotas were established, 1) nearly all casein was used in industrial products rather than food and 2) it was in the chemical, rather than food, section of the tariff code book. So the question did not arise.

The volume of casein imports is not statistically related to CCC purchases of cheese or NFDM, nor to any measure of dairy price support program costs. There is no logical basis to hypothesize such a relationship. Casein imports are related to relative prices of casein, skim milk solids, soy proteins, whey protein concentrates, and other ingredients. Casein imports are also related to technical developments which have made casein usable in food products during the past 20 years or so. They are also influenced by developments in the manufacture and use of soy proteins, whey protein concentrate, and other competing ingredients.

The question of whether or not casein imports constitute material interference with the U.S. dairy price support program involves indirect substitution of products made from casein for those which would be made from domestic skim milk solids if a quota or tariff were applied. This report analyzes that question.

SUPPLY

Casein is supplied to U.S. manufacturers entirely from foreign sources. This was not always the case; a domestic casein industry existed through the forties and fifties, and some casein was produced as late as 1968.

Economic and policy forces affecting milk and casein production in major exporting countries determine the U.S. casein supply. Because the cost of milk is the major component in the cost of producing casein, the competitive position of major exporters relative to the United States is related to costs of producing milk. In the absence of any government intervention, casein would be imported only from those countries which can produce milk sufficiently below U.S. costs to make it profitable.

But, exporting countries may choose to subsidize the production and export of their milk products. A variety of policies can be used to make milk products, including casein, competitive in world markets. To the extent that casein imports to the United States are subsidized by foreign governments, the availability and price of these dairy proteins will be influenced by policy decisions in other countries.

Casein and casein mixtures are supplied to the United States by a relatively few countries (table 1). New Zealand supplied almost half in 1984. Seven European Community countries provided 38 percent in 1984, with Ireland supplying 20 percent.

Nine countries--two in Oceania and seven EC countries--accounted for 95 percent of U.S. casein imports in 1984, 94 percent in 1983, and 96 percent in 1982. Their combined share of world casein production was 82 percent in 1984, 81 percent in 1983, and 87 percent in 1982.

Casein imports were just over 192 million pounds in 1984 and 231 million pounds in 1985 (table 1). The amount has varied from year to year depending on casein prices and stocks. Imports increased over 40 percent during the seventies, growing from 106 million pounds in 1971 to 152 million pounds in 1980. They rose another 50 percent by 1985.

Oceania: New Zealand and Australia

New Zealand and Australia, although both major casein exporters and geographic neighbors, differ significantly in their production trends. New Zealand, the principal casein exporter to the United States, has recently reached record milk production. Australia, with a less favorable set of production circumstances, made efforts to ease producers out of the dairy industry in the seventies. Both countries' dairy industries were developed to accommodate the United Kingdom's demand for imported milk products. Since the United Kingdom joined the EC in 1973, both New Zealand and Australia have sought alternative markets for at least part of their production.

New Zealand

New Zealand produced a record 16.9 billions pounds of milk in 1984 with 1985 milk production expected to increase further. Only 7 percent of that milk is consumed fresh. The rest is processed into butter, nonfat dry milk, cheese, and other dairy products. New Zealand relies heavily on dairy exports, and processed products are therefore a major end use. In 1985, 85 percent of New Zealand's dairy products were exported.

New Zealand has been shifting its exports from the United Kingdom to the United States and Japan. To accommodate these and other new markets, the commodity mix of dairy exports has changed. More emphasis has been placed on exports of casein, nonfat dry milk, and whole milk powder. This emphasis for New Zealand's dairy products has been facilitated through the operation of the New Zealand Dairy Board. This board, operated by New Zealand's dairy farmers, owns all dairy processing plants and markets New Zealand's dairy products, both domestically and overseas.

The Dairy Board has been encouraging investment in large multiproduct plants so they are better equipped to shift milk between products depending on market prices. They are also encouraging a 5-year expansion of whey processing capacity to permit increased cheese and casein production when prices are favorable. The Dairy Board owns and operates two caseinating plants in the United States to modify casein and prepare mixtures of casein with whey and other products. New Zealand's dairy policy has moved away from either encouraging or discouraging milk production. In recent years, emphasis has been on letting the market guide production. New Zealand still encourages exports of dairy products.

New Zealand has the lowest estimated average cost of milk production in the world, due to high-quality pasture available most of the year. New Zealand dairy farms are large, with average herd size the largest in the world. New Zealand's productivity per cow is growing at roughly 1 percent per

Table 1--U.S. imports of casein and casein mixtures

Country of origin	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	Million pounds															
New Zealand	63.0	37.9	29.7	31.4	33.5	14.7	56.0	96.3	84.3	92.1	76.8	76.8	85.2	68.4	94.7	102.0
Australia	34.3	31.8	27.3	23.9	18.3	10.0	33.4	23.1	22.9	21.7	17.9	18.4	16.5	18.8	15.3	12.1
Ireland	1/	.9	4.4	13.6	7.3	5.7	3.3	4.3	9.2	14.8	24.0	19.9	40.2	35.9	39.2	64.9
France	11.2	8.3	8.7	10.3	22.9	5.2	.2	1/	1/	2.0	8.9	5.8	14.9	12.0	13.9	10.7
West Germany	.4	2.3	2.6	2.5	5.5	3.5	1.2	.4	.2	.2	.6	1.2	1.2	2.6	1.5	1.9
Netherlands	.2	1.7	4.6	1.8	2.7	2.3	1.1	.6	1.5	2.5	2.5	1.8	4.6	6.0	7.9	7.7
Others	26.2	23.1	28.1	29.3	22.7	17.0	16.9	19.5	19.0	17.5	21.5	3.9	14.2	15.8	19.8	32.1
Total	135.3	106.0	105.4	112.8	112.9	58.4	112.1	144.1	137.1	150.8	152.2	127.8	176.8	159.5	192.3	231.4

1/ Less than 100,000 pounds.

Source: U.S. Department of Commerce, Bureau of the Census.

year. Thus, labor and management cost per unit of milk produced is expected to remain low.

Although the United States has purchased a large proportion of New Zealand's casein exports, a growing demand for casein in other countries may become a factor in allocating exports. The recent U.S. share of New Zealand's casein exports has ranged from 51 percent in 1980 to 70 percent in 1984. Production and supplies of casein for export are expected to continue strong.

Australia

Following the U.K.'s entry into the European Community, Australia attempted to develop new export markets while scaling back its dairy industry. In the eighties, emphasis shifted from reducing production. Australian milk production declined from 17.0 billion pounds in 1970 to 12.4 billion pounds in 1980 and then rose to 13.4 billion in 1984 and an expected 13.7 billion in 1985. Casein production was highest in 1970 when 71.2 million pounds were produced, declined to 33.1 million pounds by 1980, and further to 28.7 million in 1984. Current casein exports are well down from a decade earlier; chief recipients are the United States and Japan.

The goals for dairy programs are apparently to minimize price fluctuations, facilitate adjustments in industry structure, and increase efficiency. The Government has four major programs to ease the pressure of severe price fluctuations on the dairy industry:

- Price supports for fluid milk.
- Price supports for processed dairy products, which maintain retail prices above export (world market) prices. Manufacturers pay a levy of the difference between the government-fixed wholesale price and the assessed export price. These levies plus returns from exports are pooled by the dairy board for most processed products, with producers receiving the average price less transport, processing, and handling costs.
- Underwriting the dairy program. The Government guarantees minimum gross equalized pooled returns on certain manufactured products including casein. The support level is tied to a moving average of returns, rather than cost of production. The underwritten pool returns generally act as a floor price in case market prices drop sharply.
- Price protection from imports. Tariffs are levied on imported dairy products, most of which come from New Zealand. Also, the New Zealand Dairy Board has agreed to limit its exports to Australia. Australia seeks to maintain exports at about 20 percent of total marketings. Available export quantities of casein seem likely to range from 20 to 30 million pounds annually.

European Community

The dairy industries within the various EC countries are protected from most world agricultural supply conditions primarily by the Common Agricultural Policy. CAP's marketing and pricing arrangements can have a significant effect on the amounts of casein available from the EC in any given year.

EC Policies for Milk and Milk Products

The pricing system for EC dairy products is intended to achieve an average target price for whole milk (3.7-percent butterfat) delivered to the dairy. This price goal is achieved through "intervention" purchases of butter, nonfat dry milk, and certain cheeses; variable levies on imported milk products; and subsidies on exports to maintain control over domestic supplies. Thus, the price for whole milk is supported by purchase of products. The intervention prices for butter, nonfat dry milk, and cheese are shown in table 2.

Domestic prices in each EC country are maintained above world prices by import levies on products coming into the EC. For products for which threshold prices are fixed, the levies are equal to the difference between the threshold price and the lowest corresponding cost, insurance, and freight (c.i.f.) price. For other dairy products such as casein, levies are derived by making adjustments in the levies for the nearest corresponding product. If stocks build up as a result of intervention, export subsidies are often used to move products out of the domestic market. These subsidies bridge the gap between higher internal agricultural prices and lower world price levels, making EC products competitive on world markets. Grants have also been available to encourage use of liquid skim milk for animal feed and for processing into casein for domestic or export sales.

The EC subsidizes processing skim milk into casein and caseinates. This is the only EC manufacturing subsidy for a dairy product. The subsidy is paid directly to the processor and is adjusted periodically in light of changes in prices for casein in domestic and world markets. There is no internal price support for casein in EC member countries, nor is there a threshold price (minimum import price) established on which a variable levy is charged. Instead, imports of casein incur an ad valorem tariff ranging from 2 to 14 percent depending on the type of casein imported. Domestic EC casein prices

Table 2--EC intervention prices for dairy products

Year	Butter	Skimmed milk powder	Grana padano 1/	Parmigiano reggiano 1/
		Dollars/ton		
1980/81	3818.79	1591.29	4581.64	4986.17
1981/82	3449.20	1437.35	4170.10	4545.58
1982/83	3384.05	1415.07	4156.37	4541.42
1983/84	2960.93	1238.12	3636.67	3973.67
1984/85	2266.35	1175.92	3351.32	3697.69
1985/86	2303.90	1280.24	3533.31	3892.72

1/ Intervention in cheeses occurs only in Italy where traditional production patterns did not provide adequate support of markets through intervention purchases of butter and skimmed milk powder.

thus respond to fluctuations in world prices for casein and are roughly equivalent to world price levels. Because of the high price for liquid skim milk in the EC, a manufacturing subsidy is necessary if EC casein is to remain competitive.

Returns from casein production in the EC are determined as follows:

- Subsidy is fixed so that income from the sale of liquid skim milk processed into casein or caseinates corresponds to that from the sale of skim milk processed into skim milk powder.

- The level of subsidy is based on quantities of skim milk required for manufacturing different grades of casein or caseinates, generally 2.7 to 3.7 kilograms of casein per 100 kg. of liquid skim milk.

- Subsidy is paid only after the product has been sold.

- Subsidy varies with casein prices--

April 1980	5.75 ECU/100 kilograms
April 1983	6.50
April 1984	8.00
June 1985	8.55

Production and exports of casein from the EC increased sharply, partly in response to the subsidy in 1979. In 1978, the share of total U.S. casein imports supplied by seven EC countries studied was 10 percent; in 1980, 30 percent; in 1985, 44 percent.

Ireland

Ireland's dairy output grew rapidly in the seventies, but only 1.1 percent per year more recently. Casein production and exportable supplies have reached Australia's former levels of 40-50 million pounds annually and exports to the United States jumped 63 percent between 1980 and 1984 with another big jump in 1985.

Casein production has shown the fastest rate of growth for processed milk products in Ireland, but still trails nonfat dry milk, butter, and cheese in quantity produced. Though the total output of processed products will not continue to increase at 4-5 percent annually because of the milk delivery quotas, the production of any single item, such as casein, could change as price relationships change.

Most of Ireland's processed dairy product exports were sold within the EC in 1984. Exports of casein have increased rapidly since 1970, but have not surpassed nonfat dry milk, cheese, and butter. Nearly all of Ireland's dairy exports to the United States are casein.

West Germany

Production and exports of all dairy products are increasing in West Germany. EC policy has stimulated consolidation of West Germany's traditionally small dairy farms. West Germany is a small supplier of casein

to the United States, about 1.5 million pounds in 1984. But, growth in casein exports is expected to continue.

France

Cow milk production in France rose during the seventies and early eighties, but has declined some lately. Milk production rose 14 percent between 1969 and 1979 and output of some processed dairy products increased dramatically. Production of casein more than doubled in that period and exports kept pace with production, rising from 24 to 50 million pounds annually during the seventies. Milk output increased 5 percent between 1979 and 1983, but casein exports continued to grow, reaching 99 million pounds in 1984. After Ireland, France has been the second-largest EC supplier of casein to the United States. France accounts for a large share of the production of dairy products within the EC.

Much of France's dairy policy revolves around the CAP. Output subsidies have been substantial.

The Netherlands

Encouraged by EC milk price supports, dairying in the Netherlands has developed into a capital-intensive industry with an annual growth rate of 3 percent over the past two decades. This rate of growth is second only to Ireland in the EC. With approximately double the total milk production of Ireland, the Netherlands has the capacity to increase casein production from the 40 million pounds of 1984.

Dairy production can increase only if milk delivery quotas are raised, but casein production could easily increase over current relatively low export levels. Casein output grew 11 percent annually in the sixties and seventies, but has been fairly stable at 40-44 million pounds in the eighties.

Summary of Supply Perspective

The marketing decisions of major casein exporters are affected by the costs of producing milk, the existence of input or export subsidies on milk or milk products, and the market for those milk products. Together, these factors have a major influence on the supply of imported casein.

New Zealand is the world's leading producer and exporter of casein. Decisions by the New Zealand Dairy Board regarding the level of casein production and exports are guided by several factors: the relative price of casein and NFDM on the world market, both being subsidized; the availability of skim milk supplies; and the potential for market growth.

New Zealand subsidizes its milk production modestly. Even without this subsidy, the cost of producing milk in New Zealand would be lower than anywhere else in the world. New Zealand's output, based on low-cost forage, is limited by the availability of land to provide forage. The value of that land, which is a significant element in production costs, depends mainly on the prices in the world market, which involve subsidies by other major exporters. Australian costs for milk production are fairly close to those of New Zealand. Still, it is necessary for Australia to become quite involved through production controls, import restrictions, and the pooling of returns across dairy product sales to ensure a price that is higher than costs.

For European casein to be competitive in world markets, the EC has found it necessary to directly subsidize its production. This subsidy allows European manufacturers to sell casein at world prices; and thereby has diverted skim milk from NFDM manufacture to casein production. Subsidies for casein manufacture are directly related to the growth of the EC as a supplier of casein to the United States.

New Zealand will likely maintain its position as a major force in world dairy markets. Milk production in New Zealand will continue to expand, with milk supplies directed to casein production as long as the demand for casein remains strong and whenever the market for NFDM is weak.

Australian milk production seems likely to hold steady. Casein exports will continue to be a source of revenue for the Australian dairy industry, with export levels of 20 to 30 million pounds per year.

EC milk production is expected to continue downward as the Community implements programs to reduce the dairy surplus. Perhaps more so than for other exporters, EC casein production and exports are greatly influenced by government policies. These policies are known to change in the face of changing conditions in the dairy industry and in the economy as a whole. If current skim milk powder inventories remain high, continued subsidization of casein seems likely. If surpluses are eliminated, subsidies might be lowered. Without the subsidies, it seems unlikely that the EC would be a major supplier of casein to the United States.

MARKETS AND PRICES

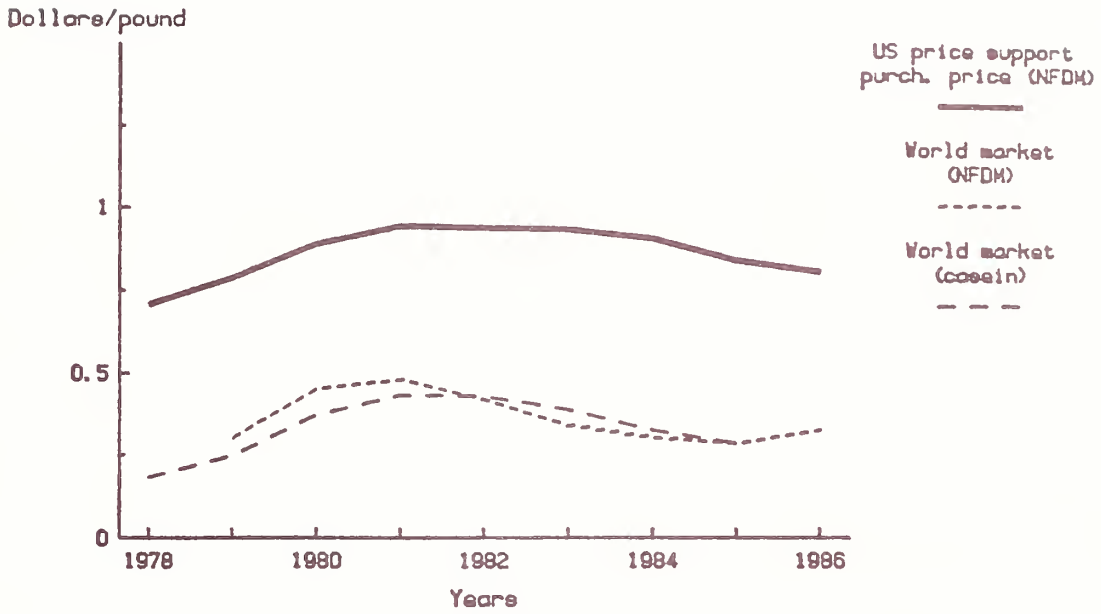
In the world market for dairy products including casein, the major sellers are EC countries, Australia, and New Zealand. Substantial elements of subsidy are involved. The supported domestic prices in most countries are well above the prices at which the large supplies of exportable dairy products can be sold in the world market. One of the limited number of markets where export sales are possible is the U.S. casein market, because casein can be sold without restriction. The U.S. prices which create that condition are shown in figure 1. Similar gaps exist in EC prices and most other exporting countries but imports are restricted.

Casein is generally sold in the world market at prices comparable to those for NFDM (fig. 1). This chart reflects the fact that three times as much NFDM as casein can be made from a hundredweight of skim milk.

A major selling point for the producers of casein is its price compared with some alternative ingredients such as NFDM. The prices of all alternative proteins change over time and their relative prices also change. NFDM price data is extensive and readily available, while that for casein and soy products is much harder to come by. This section is based on available data some of which is not adequate.

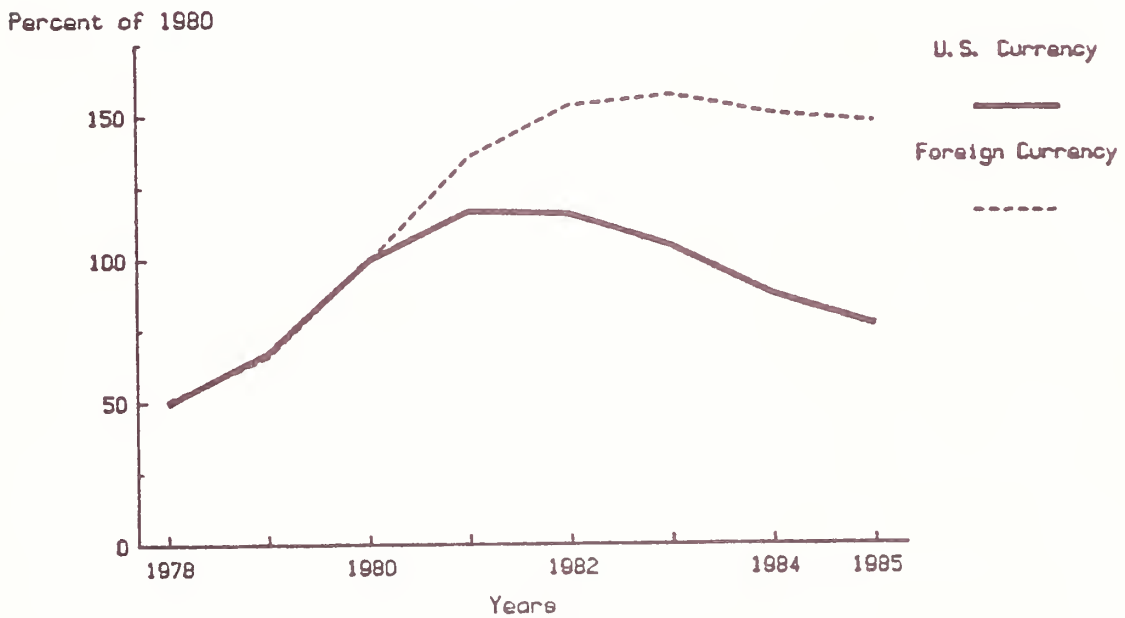
Since all casein used in the United States is imported, its price is strongly affected by exchange rates between the U.S. dollar and the currencies of major exporting countries (fig. 2). In terms of a weighted average exchange rate of major exporting countries, casein prices rose about one-half between 1980 and 1982 and have declined a little since then. In other words, most of the increase in the value of the dollar translated into higher casein prices of the exporters.

Fig. 1--Casein and nonfat dry milk prices, U.S. and World



Casein price: Value of one-third pound of casein imported into the U.S. at the dock in the supplying country (100 pounds of skim milk makes 3 pounds of NFDM or 1 pound of casein). World market price of NFDM: F.O.B. Northern European ports.

Fig. 2--Casein prices in US and foreign currencies



Import value of casein in U.S. dollars and in weighted average currencies of major exporters of casein.

The domestic price of nonfat dry milk is determined mostly by the purchase price of CCC during conditions of surplus milk production such as have existed since the late seventies. Prices are influenced both by the overall support level for milk and by the relative prices of butter and nonfat dry milk which are paid by the CCC. Since 1977, there has been a gradual increase in the relative price of butter compared with nonfat dry milk:

Date	Ratio, Butter/NFDM
Oct. 1977	1.48
April 1978	1.50
Oct. 1978	1.51
April 1979	1.54
Oct. 1979	1.56
April 1980	1.57
Oct. 1980	1.59
Dec. 1983	1.57
April 1985	1.69
July 1985	1.73

In the seventies, NFDM market prices were slightly above CCC purchase prices, while in the eighties they have been slightly below the purchase price.

Relative prices of casein and NFDM in the United States have varied substantially over the past decade. Casein values are measured here by the unit value of casein imports (not including casein mixtures, which are somewhat higher priced). These values are for imported casein at the dock in the exporting country. They do not include ocean freight, insurance, the importer's margin, and transportation within the United States.

Casein prices per pound were a little higher than U.S. support prices for NFDM in 1975 during a shortage of NFDM in the United States. They dropped rapidly to 71 percent of NFDM price in 1977 and then rose to 137 percent of NFDM prices in 1981 and 1982. In 1985, prices of casein and NFDM were again about equal.

Casein prices were below the price of soy isolate in 1978, rose rapidly to 1981, and dropped to near the same level in 1984. Soy product prices are calculated from U.S. export figures. None of these comparisons is precise (this is, the levels are not comparable), but the relative movements are useful in understanding the incentives for substitution.

U.S. CASEIN DEMAND

To evaluate the impact of imported casein on the U.S. dairy industry, one must identify major U.S. casein uses and consider the availability and costs of alternative inputs. Much of this report discusses the availability and potential use of alternative ingredients in food, feed, and industrial products. The principal alternatives to casein in food and feed over the years have been nonfat dry milk, soy products (flour, grits, isolates, and concentrates), and whey protein concentrate. The specific products which can be used in a given product vary, depending on technical considerations and relative costs of the ingredients.

Market effects of shifting between ingredients in response to changing availabilities and prices are of two kinds: shifts in the ingredients in a particular use (for example, from nonfat dry milk to casein in bread) and changes in the amounts sold of specific products using casein, in response to policy and price changes. The second category is illustrated by a potential decline in the sales of cheese analogs resulting from higher casein prices due, for example, to a quota. Higher relative prices for cheese analogs would likely translate into increased demand for natural cheese.

Historical Patterns of Use

In 1940, almost all casein went for such industrial uses as glue, adhesives, paper coatings, and paints (table 3). Developments in cosmetics and textiles in the late forties and early fifties, as well as the introduction of dried casein lactate as a dietary supplement by 1953, marked the beginning of attempts to more fully use the unique characteristics of casein. Soluble casein was made available in 1955 and by 1960 casein was used in food. In the sixties, development of casein's properties--especially emulsifying and stabilizing qualities--facilitated successful introduction of a powdered nondairy coffee whitener. Imitation milk using casein and vegetable fat was introduced in 1966 but nearly disappeared by the mid-seventies. By 1969, as much as one-quarter of the world's annual production of casein (estimated to be about 240 million to 320 million pounds) is believed to have gone into coffee whiteners and other food. Other major edible applications were: medical/dietary products, flavor enhancers, imitation whipped cream for desserts/bakery goods, and meat products, such as sausage and luncheon meats.

In 1969, most U.S. casein was still used in industrial products, although over 20 million pounds of casein were used in foods. These food uses were limited to beverages, breakfast foods, coffee whiteners, desserts and toppings, and dietetic food products. Casein had not yet been widely used in baby foods, baked goods, confectionery products, processed meats, dry soups, and pet foods.

Casein has functional as well as economic characteristics that determine its uses. The use of casein in feed, food, and industrial products and the availability of alternative ingredients is discussed below.

Feed

Major products in the feed category include calf milk replacers, animal feeds (for example, horse feeds and feed supplements), pet foods, veal feeds, and weaning feeds for young pigs. All of these feed products use casein.

Casein's primary role in feed is to provide quality protein to meet nutrition requirements. All respondents to the 1980 USDA survey in this end-product category indicated that high protein quality was the most important factor favoring casein over alternatives. Because it imparts certain functional characteristics (the ability to encapsulate fat particles in high-fat veal feeds and to enhance appearance, nutrition, and convenience in certain brands of dry dog food), casein plays a broader role than protein fortification in some products.

Table 3--Casein supply and use

Year	Imports	Production	Change in stocks	Exports	Estimated domestic use				
					Total	Food	Feed	Industrial	Other
				Million pounds					
1940	24.5	46.6	--	--	60.2	*	*	56.4	3.8
1950	54.6	18.5	+.3	0.1	72.7	--	--	--	--
1965	74.5	3.1	--	.1	77.5	1.0	*	*	76.5
1960	92.2	.9	--	.1	93.0	4.7	--	--	--
1966	107.9	2.7	--	3.6	107.0	22.5	*	79.5	5.0
1970	135.0	0	--	3.7	131.6	39.5	26.3	65.8	0
1971	106.0	0	--	2.5	103.5	32.1	--	--	--
1972	105.4	0	--	1.9	103.5	33.1	--	--	--
1973	112.8	0	--	1.9	110.9	36.6	--	--	--
1974	112.9	0	--	2.3	110.6	37.6	--	--	--
1975	58.4	0	--	.7	57.7	--	--	--	--
1976	112.1	0	--	1.1	111.0	72.9	--	--	--
1977	144.1	0	--	.9	143.2	65.9	--	--	--
1978	137.0	0	+6.6	1.2	129.3	72.4	30.4	26.6	0
1979	150.8	0	+2.1	.7	148.1	87.7	32.1	28.2	0
1980	152.2	0	+12.3	1.0	138.9	95.8	22.7	20.5	0
1981	127.8	0	-15.4	.9	142.4	100.6	22.9	18.8	0
1982	176.8	0	-2.6	.6	178.8	136.1	23.6	19.0	0
1983	159.5	0	-28.7	1.2	187.0	142.1	--	--	--
1984	192.3	0	-4.5	2.8	194.0	146.7	--	--	--
1985	231.4	0	+33.3	2.3	195.8	146.9	23.9	25.0	0

* If any, included in other.
-- Not available

Sources of use data:

1940: USDA, Dairy Situation, DS-168, August 1945, p. 12.
1955: U.S. Tariff Commission, Summaries of Trade and Tariff Information, Chemicals and Related Products, TC Publication 239, November 1967, p. 58.
1966: Poarch, A.E., "Uses of Casein and Caseinates in the Industry in General and in the Food Industry," International Dairy Federation Seminar on Casein and Caseinates, Paris, 1967, p. 7.
1970: Hammonds, T.M., and Call, D.L., Utilization of Protein Ingredients in the U.S. Food Industry, Part I - The Current Market for Protein Ingredients, Cornell University, A.E, Res. 320, July 1970, p. 21.
Dairy Situation, DS-334, March 1971, p. 36.
1978-81: International Trade Commission.
1982: Census of Manufacturers (partial).

Calf Milk Replacers

Calf milk replacers use casein primarily because it is cheaper than milk. When introduced in the fifties, calf milk replacers were made from by-products of the butter and cheese industry: dried skim milk, dried buttermilk, and dried whey. As skim milk prices rose in the midsixties and "simulated skim milk" (a casein and whey mixture) was found to perform as well as skim milk-based feeds, casein began to be used. Estimates of the market share of casein-whey calf milk replacers are difficult to obtain, but it appears that casein use may be down since the midseventies.

Young calves can readily use only two carbohydrates: lactose and dextrose. In order to make a digestible product, milk replacer manufacturers must either use NFDM or recombine casein and whey (which is over 50-percent lactose), as dextrose is too expensive for use.

High-quality calf milk replacers require milk-based protein sources. USDA survey respondents indicated that soy protein concentrate could be used as a partial replacement for dairy-based proteins in calf milk replacers. Up to 22-30 percent of calf milk replacer protein can be derived from specially manufactured soy protein or soy concentrates, while still producing an acceptable product. The remainder of the product's protein content would be based on skim milk powder. Whey protein concentrate can also provide a substantial share of the protein.

Animal Feeds

Other feeds, such as supplemental feeds, use casein primarily for protein. Some manufacturers could substitute NFDM and/or additional whey for casein, if imported casein were no longer available. According to many professionals, animal feeds made from NFDM would not be identical to animal feeds made from casein. However, the NFDM feeds would be acceptable, especially pig-weaning feeds. If casein prices were to rise to a level where NFDM was an economically viable substitute, animal feed manufacturers would attempt to extend the NFDM by adding soy or whey protein. Specialty feeds for horses and certain feed supplements need a quality protein source. Casein use is favored over skim milk powder in these specialty animal feeds because it is free of lactose. There are no good substitutes for casein in specialty feeds.

Veal Feeds

Veal feeds use casein to encapsulate fat particles and supply protein to the growing veal calf. Since many modern veal operations are not connected to dairy operations, they must use prepared milk replacers that can be reconstituted on the veal feeding site. Thus, convenience is an essential quality in these veal feeds.

Milk-based proteins are considered the best source of protein for these products. All manufacturers of this product felt that they would not be able to supply the same quality of product without using casein. But, feed experts agree that manufacturers could make a similar product using, for the most part, NFDM to supply the protein and functional characteristics.

Pet Foods

Pet food products use casein because it is a high-quality protein and because it can impart certain functional characteristics such as the ability of the casein product to closely resemble fresh meat when water is added.

A limited response was received from firms in this product class in the 1980 survey. Several large casein users maintained that their pet food product could not be supplied without casein. However, one producer did state that, if casein were not available, NFDM could be used. At least one manufacturer of pet food has switched from casein to alternative ingredients since 1980. However, much of the pet food now on the market is made with soy protein and contains no casein. Soy protein must be considered a viable alternative to casein in pet food manufacture.

Food

Major food products include cheese analogs, nondairy coffee whiteners, dietary products, imitation dairy products, and bakery products. Other uses include confectionery products, meat products (such as luncheon meats), and nutritional and specialty foods.

Cheese Analogs

The variety of products included in the cheese analog group is increasing. Present products include the following and probably others:

- Cheese substitute -- must have the same composition as natural cheese. Made from casein, vegetable oil, and water.
- Imitation cheese -- does not have the same composition as natural cheese, primarily because it has less fat. It can be made from proteins other than casein, such as soy, although very little appears to be made using soy because it is a less acceptable product.
- Blended products -- at least one manufacturer blends 51-percent natural cheese and 49-percent imitation in a product similar to processed cheese.

Relatively little cheese substitute is made. The blended products seem to be growing in importance. Use of casein in American-type cheese analogs increased more rapidly than in Mozarella-types between 1978 and Jan.-Aug. 1981, according to the ITC: from 45 percent in 1978 to 48 percent in 1980 and 51 percent in Jan.-Aug. 1981. The 1982 Census of Manufactures divides its category of "cheese substitutes" in a different way: 43 percent in products substituting for processed cheese and 57 percent in products substituting for natural cheese. The Annual Survey of Manufactures reports that the value of shipments of cheese substitutes dropped 0.3 percent between 1982 and 1983.

Casein provides the protein component that binds together fat and water, with some additional minerals and a small amount of carbohydrate. Casein also gives cheese analogs proper texture and the capacity to be melted, cooled, and melted again without burning and changing flavor. These functional properties are important because most cheese analogs are used in more highly processed food products such as frozen and restaurant pizza and prepared dinners.

Cheese analogs make up about 5 percent of the commercial disappearance of all cheeses in the United States (table 4). Most cheese analogs are used in frozen and restaurant pizza, with less than 30 percent sold at retail. About half of natural and processed cheeses are used in restaurants and institutions, much of it on pizza.

Coffee Whiteners and Dessert Toppings

Coffee whiteners must change the color of coffee, add a slight cream flavor, offset somewhat the bitter taste of coffee, be convenient to use, and have a long shelf life. Coffee whiteners containing sodium caseinates succeed. They also appeal to consumers who want to reduce intake of animal fat.

Sodium caseinate's most important traits in these products are its ability to prevent the fat component of powdered coffee whitener from rising to the top of the emulsion (commonly referred as feathering) and its ability to retain stable flavor and color during storage. The principal viable technical substitute for sodium caseinate in powdered coffee whiteners is soy protein. Powdered coffee whiteners made with soy protein are available, but they are inferior to those manufactured with sodium caseinate because of poor taste (due to the soy ingredient) and poor emulsifying properties. These soy-based products cater to religious groups who must restrict their intake of dairy products. On the other hand, liquid coffee whiteners made from soy isolates are currently marketed and find wide consumer acceptance, although they do not have the shelf life of powdered coffee whiteners. The technology for formulating soy-based liquid coffee whitener is not widely known in the industry.

If imported casein were no longer available, powdered nondairy whiteners would probably use domestically produced casein. These products require long shelf life and good flavor; it may therefore be assumed that casein would be used to supply those attributes. The market share of coffee whiteners used at home is estimated to be 80 percent of the total market. The restaurant and institutional trade would most likely begin to use a product using skim milk and vegetable fat. Because coffee whiteners and many dessert formulations

Table 4--The U.S. cheese market, 1985

Production/use	Natural cheese	Processed cheese	Cheese analogs	Total
		Million pounds		
Production	5,025	1,876	282	7,183
Used in processed cheese	1,510	0	0	1,510
CCC removals	129	500	0	629
Net imports and stock change	269	--	0	269
Domestic commercial disappearance	3,655	1,376	282	5,313
Used in other foods 1/	98	--	102	200
Restaurants and institutions	2,383	630	100	3,113
Retail	1,174	746	80	2,000

-- Not available
1/ Mostly frozen pizza

Cheese analogs make up about 10 percent of the commercial disappearance of all cheeses in the United States (table 4). Most cheese analogs are used in frozen and restaurant pizza, with less than 30 percent sold at retail. About half of natural and processed cheeses are used in restaurants and institutions, much of it on pizza.

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Table 4--The U.S. cheese market, 1985

Production/use	Natural cheese	Processed cheese	Cheese analogs	Total
		Million pounds		
Production	5,009	1,900	282	5,291
Used in processed cheese	1,500	0	0	1,500
CCC removals	129	500	0	629
Net imports and stock exchange	308	--	0	308
Domestic commercial disappearance	3,072	1,400	282	4,354
Used in other foods 1/	98	--	102	200
Restaurants and institutions	1,800	655	102	2,154
Retail	1,174	746	80	2,000

-- Not available
1/ Mostly frozen pizza

(especially substitute topping products) are similar, similar assumptions apply to the home and away-from-home share of dessert topping markets. To the extent that soybean isolates and whey could be substituted for the casein/caseinate portion, less casein (imported or domestically produced) and less skim milk would be required in the manufacture of both of these products.

Dietary Products

The dietary products group involves specially formulated food and medical products low in cholesterol and lactose-free. Caseinate-based products provide a protein source easily introduced into and accepted by the body for consumers with medical problems related to poor food intake and digestion, lactose intolerance, or sensitivity to protein from milk, soy, or other protein sources. Other products include coatings and binders for pills, weight reduction formulations, protein powder formulas, and other special dietetic and infant food products. No technical substitutes could be found that would replicate casein's role in the majority of these products.

Thus, if imported casein were no longer available for use in these products, production could cease. Manufacturers might use domestically produced casein if they felt that their products could be sold at the increased price levels reflecting increased ingredient costs. Many companies surveyed in 1981 responded that, if casein prices increased and domestic production of casein became viable, they would produce their product overseas where casein is available at lower cost, unless laws prohibited importation back into the United States.

Bakery Products

The desired characteristics of many bakery products using casein and/or caseinates are good crust formulation, moisture retention, taste, flavor, texture, and nutrition. Many of these characteristics were once imparted by adding nonfat dry milk to bakery mixes. However, changing technology and relative prices led to the development and introduction of nonfat dry milk replacers in the sixties. These NFDM substitutes have eroded what was once the largest domestic market for nonfat dry milk.

Many of these milk replacers contain casein; however, there are replacers available which contain little or no casein or caseinate, but rely on soy proteins--especially soy isolates--and whey. These soy-based milk replacers can impart the desired characteristics for many products.

In bread baking, casein interacts with the sugar component to build body or structure and retain moisture. Casein's high water-binding capacity is important in controlling texture and uniformity in doughnuts, cookies, waffles, and yeast-raised doughs.

In the past, soy proteins extended many NFDM replacers and, in some applications, such as breads, soy flour, and soy concentrate/whey blends, replaced milk-based protein. In some bakery applications, such as cakes, soy isolates reportedly can replace caseinates and/or nonfat dry milk; in others, blends of soy isolate and caseinate can further reduce caseinate use by 90 percent.

If imported casein were no longer available to bakers, their use of soy protein would increase. Also, at higher prices for casein, little casein

and/or caseinate would be demanded except to produce some specialty items such as glazes on breads. The quantity of NFDM demanded would increase only slightly if imported casein were not available.

Other Foods

Meat products, such as imitation sausage, stews, and soups, need an ingredient that can bind water in the product and reduce fat exudation. In many imitation dairy products, an ingredient which prevents weeping of liquids from the product is also desired. In most of these products, skim milk solids could be used; casein and/or caseinates are used mainly for economic reasons. Thus, this diverse group of products can be grouped because they could use skim milk solids; most do not because of higher cost.

Soy proteins could replace casein in certain of these uses. Complete replacement of dairy protein is reportedly possible in many cream fillings, icings, and whipping creams; but further development of soy protein products is apparently necessary.

Industrial Products

Major products in the industrial category include adhesives, glues, and paper coating products. Other products include paint, rubber and leather products, as well as a miscellaneous group containing lubricants, cleaning agents, and related products. All these major industrial products except leather use both casein and caseinates.

Adhesives and Glues

Desired characteristics of adhesives and glues containing casein or caseinate mixtures are quick-setting ability, water-resistance, durability, the ability to adhere to different surfaces (such as paper on glass, aluminum foil to paper), and convenience. Casein serves as the main binding agent in the adhesive mixture. The colloidial properties of casein have been recognized for some time. Many users indicate that casein in the adhesive mixture results in a product resistant to water and temperature extremes (important in bottle labeling) and stable when mixed with water.

There are few perfect technical substitutes for casein in the production of glues and adhesives. Some glue and adhesive manufacturers indicated that soy-based proteins and synthetics such as polyacrylate could be substituted for casein. But, most responses in this category claimed that soy or synthetic-based glues and adhesives would be inferior to casein products. In the past, when casein prices increased, many glue manufacturers have substituted soy protein for casein.

Paper Coatings

Paper coatings should bind color and print to paper and be waterproof. Casein provides that binding quality. Technical substitutes for casein in paper coating products include soy protein, starch, synthetic-resin material, and combinations of these materials. Soy substances have been available since the late forties. Together with starch (the former leading adhesive in paper coating), all casein use in paper coating would likely be eliminated if

low-cost imported casein were unavailable. Many companies began switching to substitutes, primarily soy, in response to increases in the price of casein in the seventies.

Other Industrial Products

The major products are leather, rubber, and paint. Casein serves as: 1) a combined dispenser and binder of pigments in leather finishes, and a glaze and protective shield for many leather products; 2) a dispenser agent in the manufacture of rubber-dipped goods, such as gloves, medical supplies, and balloons; and 3) a stabilizer for resin-emulsion and latex paints.

In these uses, except perhaps rubber products, suitable alternatives for casein exist and have been used. In the miscellaneous industrial grouping (including hair setting lotion, lubricating fluids in insecticide formulations, lace scouring cleaning agents, spackling paste, and resilient floor covering), the use of casein is so specialized that replacements do not exist.

Classification of Casein Uses

Casein uses can be classified into three groups (table 5). Group C includes products in which soy proteins, whey proteins, or synthetics could replace casein. In some cases (certain pet foods and glues), soy proteins are not perfect substitutes for casein, but they would be acceptable. Group B includes products in which nonfat dry milk or fluid skim milk could replace casein. In certain imitation dairy products, NFDM or skim milk could replace casein and be combined with vegetable fat, resulting in a filled dairy product. Group A contains products for which there are no apparent technical substitutes for casein.

ECONOMIC IMPLICATIONS OF RESTRICTIONS ON CASEIN IMPORTS

In order to assess the impact of casein imports on the U.S. dairy price support program and determine the effects of limiting imports of casein, it is necessary to have an understanding of how the market (that is, supply and demand) for casein operates.

Supply

The United States is the world's largest user of casein, but produces none because casein's price is not high enough relative to the supported price of NFDM to attract skim milk into the production of casein. Still, there is some price (P_d) at which edible-grade casein would be produced in the United States. When the price is below this level, casein will be supplied only from the world market. When the price reaches P_d, the supply relationship will be relatively flat over some range as the casein industry draws off surplus quantities of skim milk without raising milk prices above support levels (fig. 3).

Demand

Casein is an input in the production of other products. The shape of the demand relationship for casein, therefore, will be influenced by the technical requirements for casein and other production inputs, by the availability and prices of alternatives for casein, and by the demand for the final products in which casein is used.

Table 5--Casein use by product group, 1980 1/

Use group	Casein use
	Million pounds
Group A--Alternatives to casein not available:	
Coffee whitener (80%)	10.6
Dietary products	12.5
Desserts and toppings (72%)	3.7
Bakery (10%)	.7
Total	27.5
Group B--NFDM or skim milk can replace casein:	
Cheese analogs	44.7
Animal feed (20%)	3.7
Coffee whitener (20%)	2.7
Desserts and toppings (28%)	1.5
Other foods	13.5
Total	66.1
Group C--Soy or other protein can replace casein:	
Industrial	20.5
Bakery (90%)	5.9
Pet food	4.4
Animal feed (80%)	14.6
Total	45.4

1/ Percent in parentheses is estimated share of casein use in that product falling in that substitution category. Figures for 1980 are based on the ITC report.

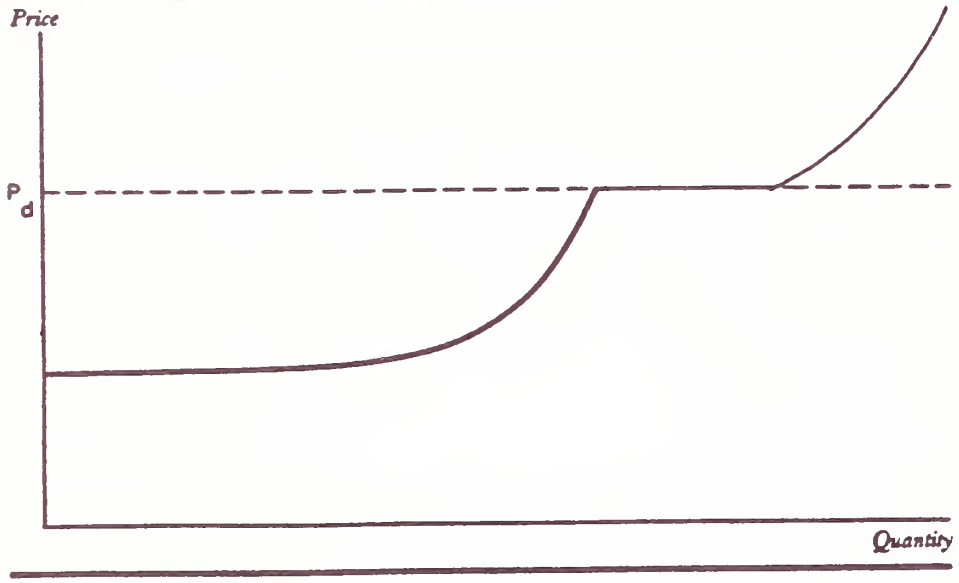
Casein is a specialized input for some products. For certain other products, there do exist, however, technical substitutes for casein mixtures such as NFDM and soy isolates. These substitute inputs can be used instead of casein mixtures, replacing casein in some technically fixed ratio. The choice between these inputs will depend on their relative prices and technical relations.

The demand relationship for casein will have plateaus where the price of casein encourages large classes of users to switch from one input to another. Between the plateaus, the quantity of casein demanded will decline as the price goes up, because, as casein gets more expensive and consumers use less of these products, less casein is needed. The demand relationship for casein will look something like figure 4.

When the casein price reaches some level (P*), casein becomes more expensive than soy protein and other ingredients. There is a "plateau" in the

Figure 3

The Supply Relationship for Casein



demand relationship at this price, as casein users switch to soy protein or other ingredients where possible. As the price rises above P*, other users continue to use casein, but they must raise the prices of their products to reflect higher casein prices. Consumers then demand less of products containing casein and less casein is needed to make these products. When the price of casein reaches P**, casein becomes more expensive than NFDM, and many users switch out of casein into skim milk solids. There will also be a plateau in the demand relationship at this price. At prices above P**, casein will be used only for products when there is no good substitute.

The supply and demand relationships described above do not present a completely realistic view of the market for casein. A domestic casein industry would not be expected to suddenly appear when prices reached P_d. Nor would every use for casein have either a perfect substitute or no substitute at all (the plateaus in the demand relationship are not perfectly flat). But this representation of the casein market does aid in understanding the impact of casein imports on manufacturers using casein, the domestic dairy industry, and the dairy price support program.

Estimation of Casein Supply and Demand

Available information on the production and use of casein and discussions with those in industries that use casein provided insight as to what the supply and demand relationships look like and where the kinks occur (fig. 5).

The price at which casein would be produced in the United States (P_d on the supply relationship) can be estimated from the NFDM price. Domestic supplies of skim milk would be shifted between domestic production of NFDM and production of casein until the price returned to farmers is the same for both products. The value of milk in both uses can be calculated from data on product prices, yields, and costs of processing.

The yield factors are technical coefficients: from 100 pounds of skim milk, 8.8 pounds of NFDM can be made, or 2.8 pounds of casein. The whey left over from casein production is likely to bring no return. The CCC purchase price of NFDM was $0.84 cents per pound in 1985, so the price of casein would have to be $2.49 in order to induce domestic casein production.

On the demand side, if the casein price rises above $2.49, those users who could do so would shift to NFDM or skim milk. Therefore, the higher plateau on the demand relationship would be at about P**=$2.49 in 1985.

This plateau occurs at different price levels over time, depending on the price of nonfat dry milk. The level rose from 1980 to 1981-83 and has fallen since then:

Date	Dollars per pound of casein
1980	2.66
1981	2.83
1982	2.81
1983	2.80
1984	2.71
1985	2.49
March 1986	2.38

The price at which the lower plateau occurs (where casein users switch to soy, whey, or other ingredients, if such a switch is technically feasible) is more difficult to pinpoint. However, the trend of glue, paper, and pet food manufacturers away from casein to other proteins suggests that recent price levels are high enough to encourage substitution of other proteins for casein.

The information in the preceding section allows identification of those casein users which would be shifted to alternative protein sources, such as soy protein, whey, and synthetic materials (group C), those who would shift to skim milk solids (group B), and those who would continue to use casein (group A), as the price of casein rose. Table 5 contains estimates of the quantity of casein in each category used in 1980.

The estimates for 1985 are rough approximations based on the 1980 figures, partial data for 1982 from the Census of Manufactures, trends in the sales of products using casein, and discussions with some casein users:

Use group	Mil. lbs.
Group A - No alternatives	51
Group B - Skim replaces casein	94
Group C - Soy, whey, or other protein replaces casein	51

The increase in casein inventories in 1985 was large but whether it was as large as these figures imply is problematical. The Census figures for 1982 imply a large increase between 1980 and 1982 in casein use for cheese analogs and an even larger increase for a group including coffee whiteners and dietary products. There do not appear to have been more than modest increases since then.

As the casein price rises above P*, the quantity of casein demanded would drop by 51 million pounds, as group C users switch to soy or whey proteins or other ingredients.

As the price approaches P**, casein would still be used for group A and B products, but the quantity demanded for certain of these products would be lower and the quantity of casein used would decline.

For many uses in group B, casein is a small factor in the value of the final product. Even a large increase in the casein price would have a minor impact on the retail prices of these products, and the quantity demanded should not be greatly affected. For the dietary products category, the quantity demanded would hold fairly constant no matter what the price, since the consumers of these items have special need for the products.

However, the prices of cheese analogs, calf milk replacer, and other animal feeds would increase significantly as the casein price rose to P**. The price of cheese analogs and calf milk replacer could increase by about 30 percent. As a result of these price increases, users would demand less of these products and demand for casein would fall by about 7 million pounds (assuming demand elasticities of -0.33).

The remaining casein--51 million pounds in group A--would be used at any price in pharmaceuticals and specialty products where casein is a necessary ingredient but not a significant part of the value of the end product.

Economic Effects of Restricted Casein Imports

The actions permitted by Section 22 of the Agricultural Adjustment Act of 1935 to curtail casein imports are a quota of 50 percent or more of imports in a representative period or an ad valorem tariff up to 50 percent. For purposes of illustration, a quota based on 1981-1985 will be used. An ad valorem tariff of 50 percent of the value would add $0.48 cents to the 1985 price of about $0.96 cents per pound of casein.

Impacts on Casein Users

If a 50-percent tariff were imposed and the casein price rose to $1.44 per pound, many casein users would shift where possible to other ingredients, primarily whey proteins, soy proteins, and synthetics (see fig. A in Summary). About 46 million pounds of casein would be replaced by these proteins. All remaining casein users would continue to use imported casein; in some products, casein use would decline because consumer demand for the final products would decline due to higher prices. About 130-135 million pounds of casein would be imported and used if a 50-percent ad valorem tariff were imposed. Little increase in the use of domestically produced skim milk solids would result.

If a quota were imposed limiting imports of casein to 88 million pounds (50 percent of average imports in 1981-85), most group C users would shift out of casein into alternative proteins. Total demand for casein by other users would also drop. Casein use in group B products would decline by around 57 million pounds.

Competition for casein by users in groups A and B would bid up the price of casein to approximately the level where domestic casein production would become feasible. An increase of casein prices to $2.49 would raise the

Figure 4

The Demand Relationship for Casein

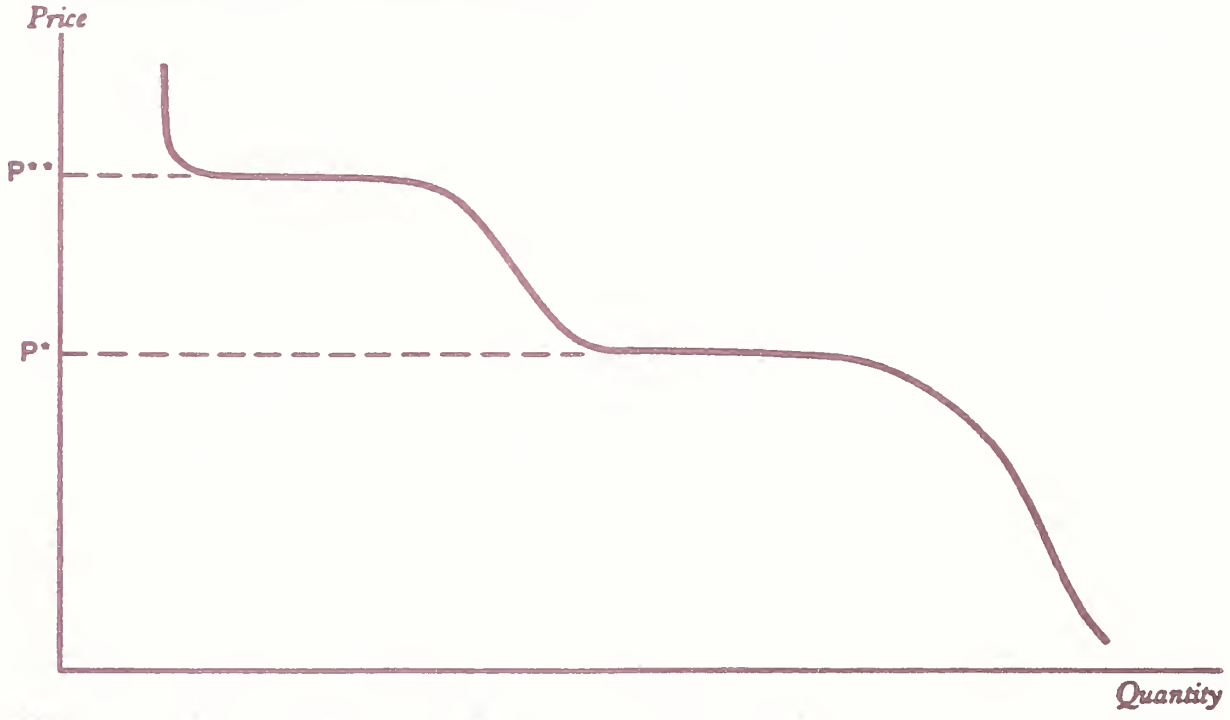
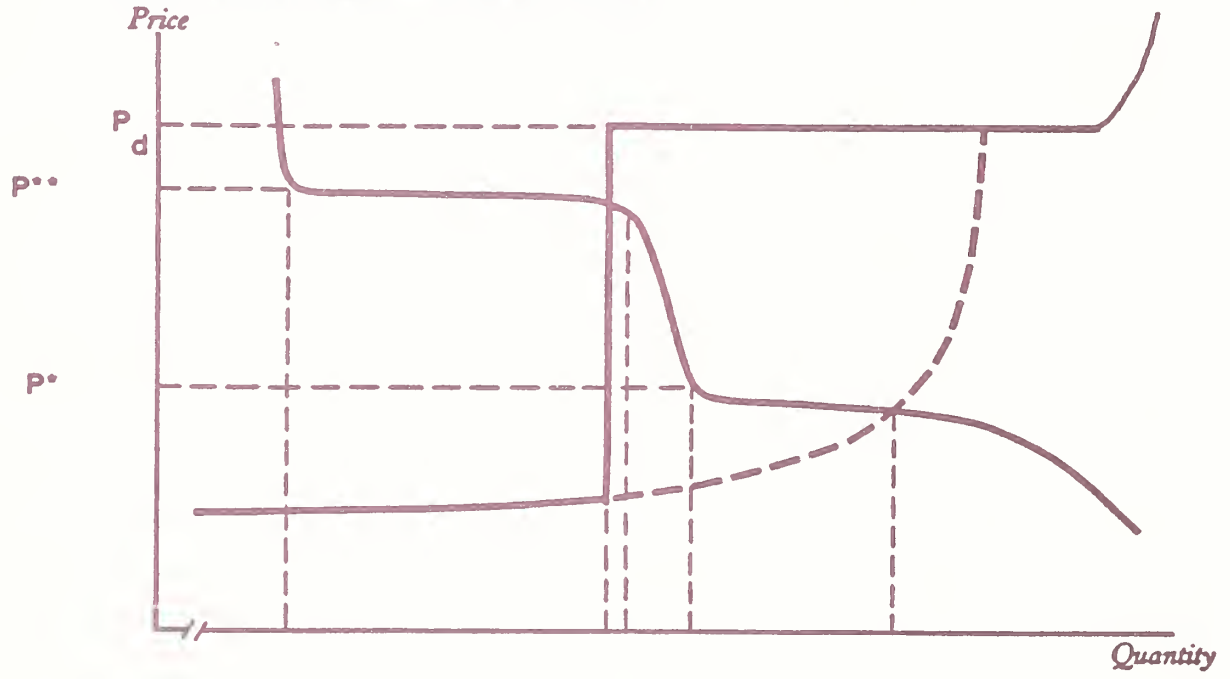


Figure 5

Supply and Demand in the Casein Market



ingredient cost of cheese analogs about 37 cents per pound of analog and make it about the same as for natural cheese. It could cause a shift in usage toward noncasein cheeses. Given the scarcity of data in general and the complete lack of information on the probability of different competitive moves by manufacturers of cheese analogs and of natural cheeses, firm conclusions are not possible. The range of possible outcomes extends from (1) a shift from analogs to natural cheese, limited to that caused by a narrowing of the price gap due to the higher price of casein, to (2) a complete displacement of analogs by natural cheese.

Impacts on Dairy Program Costs

Because a 50-percent tariff would not increase commercial disappearance of skim milk solids by much, the tariff would have no impact on CCC purchases under the dairy program. The ingredient cost of cheese analogs would rise about 12 cents per pound of cheese analog which would still leave it substantially below the ingredient cost of natural cheese. If this narrowed the price differential between analogs and natural cheese by 12 cents or more, there might be some shift in demand toward natural cheese but it would be small.

The effect of a quota of 88 million pounds depends on the extent to which natural cheese displaces cheese analogs and skim milk solids displace casein in products now using casein. If the effects were limited to the displacement of 32 million pounds of casein by skim milk solids, commercial disappearance of skim milk solids would increase by the equivalent of about 100 million pounds of NFDM (3.16 pounds of NFDM are required to replace 1 pound of casein in commercial use). CCC purchases would decline by this amount, reducing Government costs by about $84 million (based on the 1985 NFDM support price of $0.84 per pound), or 3 percent of 1985 dairy program costs of $2.2 billion.

At the other end of the range of possibilities, natural cheese might replace all cheese analogs because of the increase in the costs and prices of analogs. In such a case, estimated 1985 sales of cheese analogs of about 280 million pounds would be replaced by commercial sales of about 240 million pounds of natural cheese (on the basis of a price elasticity of -0.33). This could reduce CCC costs by about $300 million. Thus, the range of possible effects on Government costs is $84-300 million.

Impacts on Consumer Costs

A 50-percent ad valorem tariff, adding $0.48 to the price of casein, would increase the ingredient cost of consumer products annually by $66 million, given the continued use of 138 million pounds of casein.

A 50-percent quota would raise the price of casein to about $2.49, compared with the 1985 price of $0.96 per pound. Total casein imports would be limited to 88 million pounds, with 32 million pounds of the displaced imported casein being replaced by domestic skim milk solids. A total increase in the ingredient cost of consumer products of $180 million would be expected.

Those products for which soy proteins would be substituted for casein would realize no significant price impact.

Effects on Consumer Choice

Since not all consumers have the same tastes, needs, and wants regarding product and price, the general level of consumer satisfaction can be expected to increase as diversity of both product and price increase, up to some point. The imposition of a tariff or a quota which drives up the price of casein would result in higher prices for the products that use casein. In some cases, such restrictions could mean the elimination of products from the marketplace. Consumer choice would be constrained in either situation. Cheese analogs, for example, are now sold at lower prices than natural cheeses because of the availability of imported casein at substantially lower prices than domestic skim milk solids. A quota would raise the ingredient cost of cheese analogs, thereby raising the cost of cheese analogs to consumers and possibly limiting their availability. Consumers would have fewer cheese alternatives, some at higher prices. For products where substitution of ingredients is possible, a different and possibly less preferred set of consumer choices would be available. Presumably a technical or cost advantage or both exists for products in which casein is presently being used; so that an increase in its price or a limit on its availability would impact on consumer choice with regard to product or price.

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